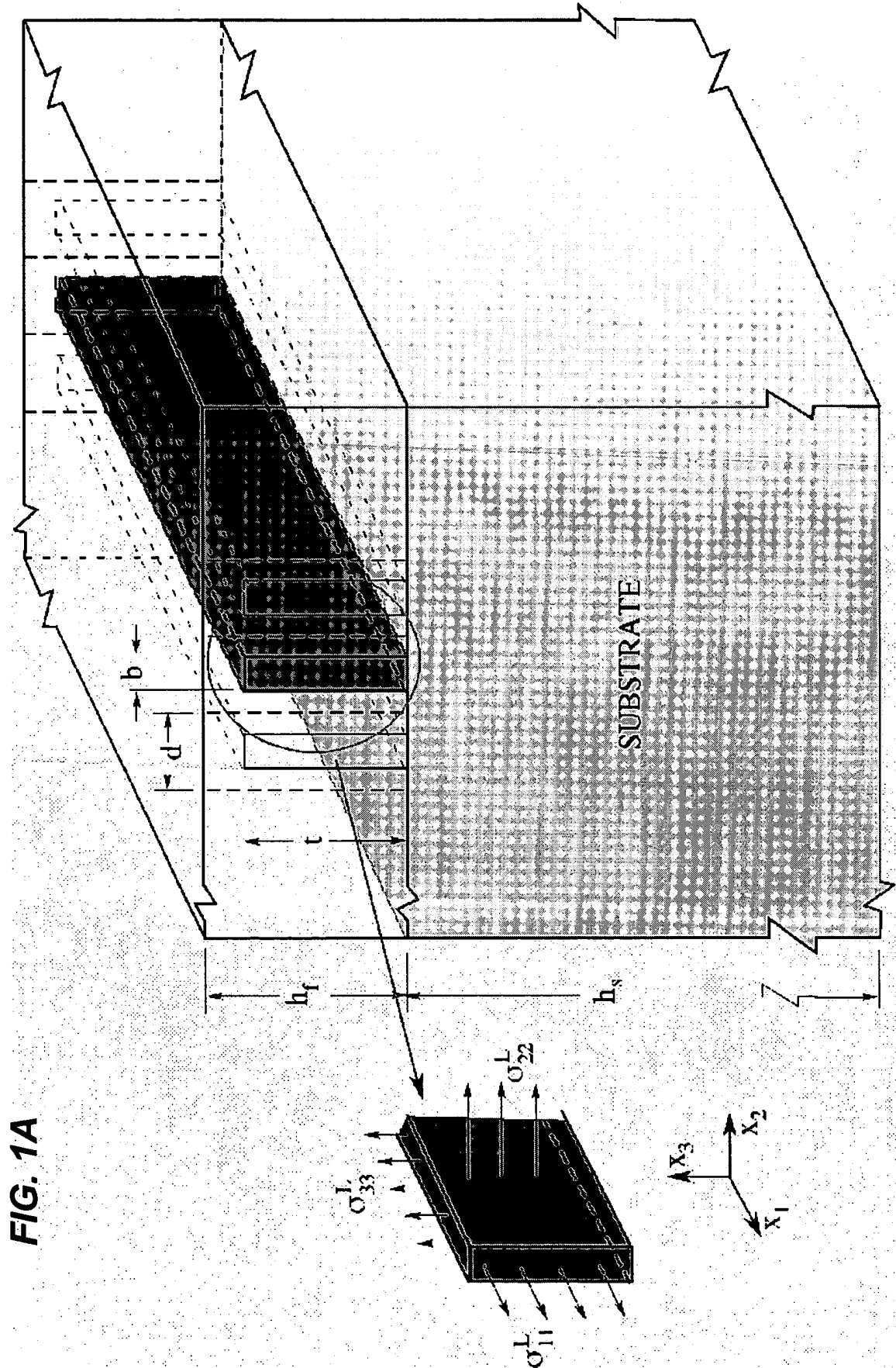
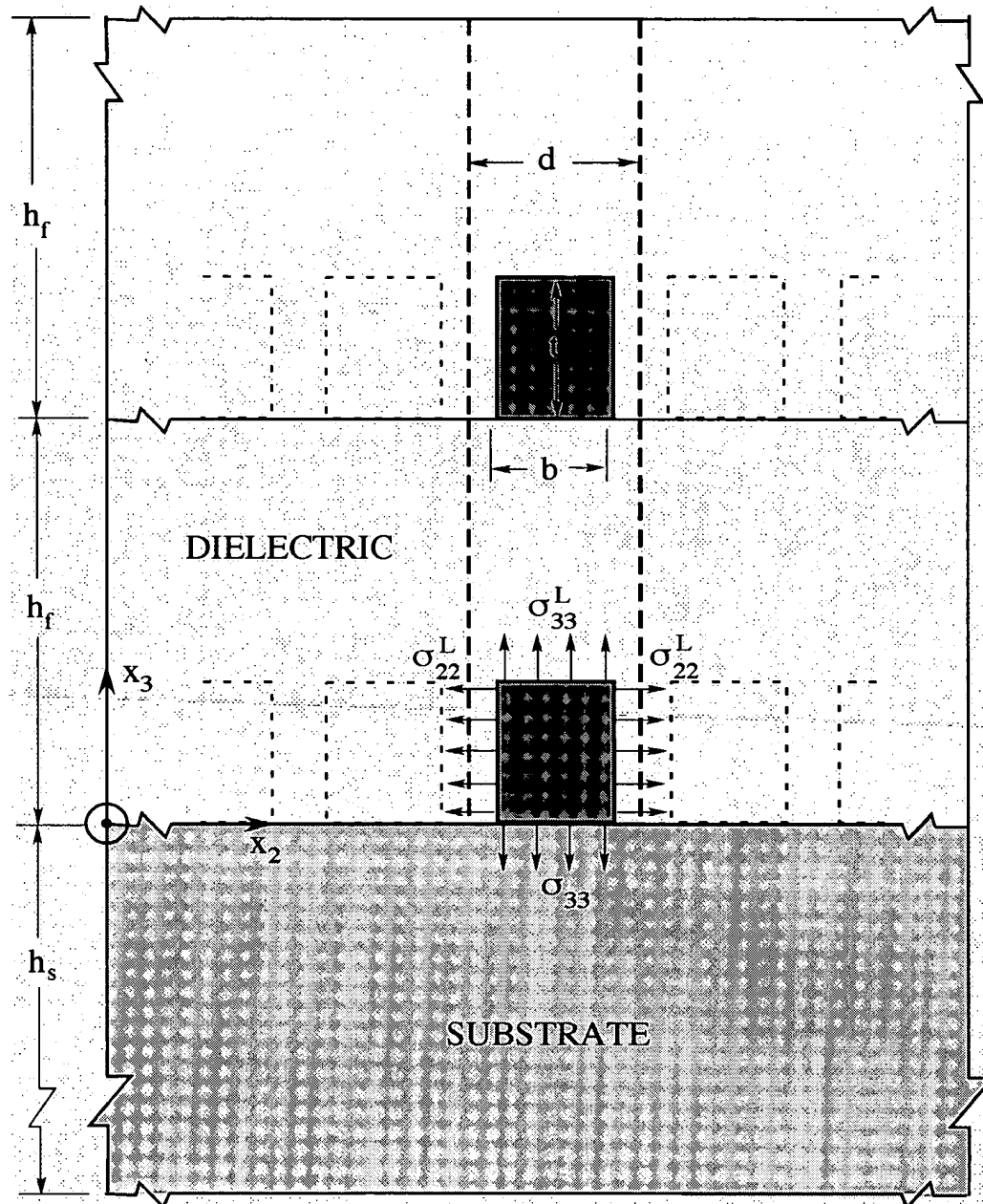
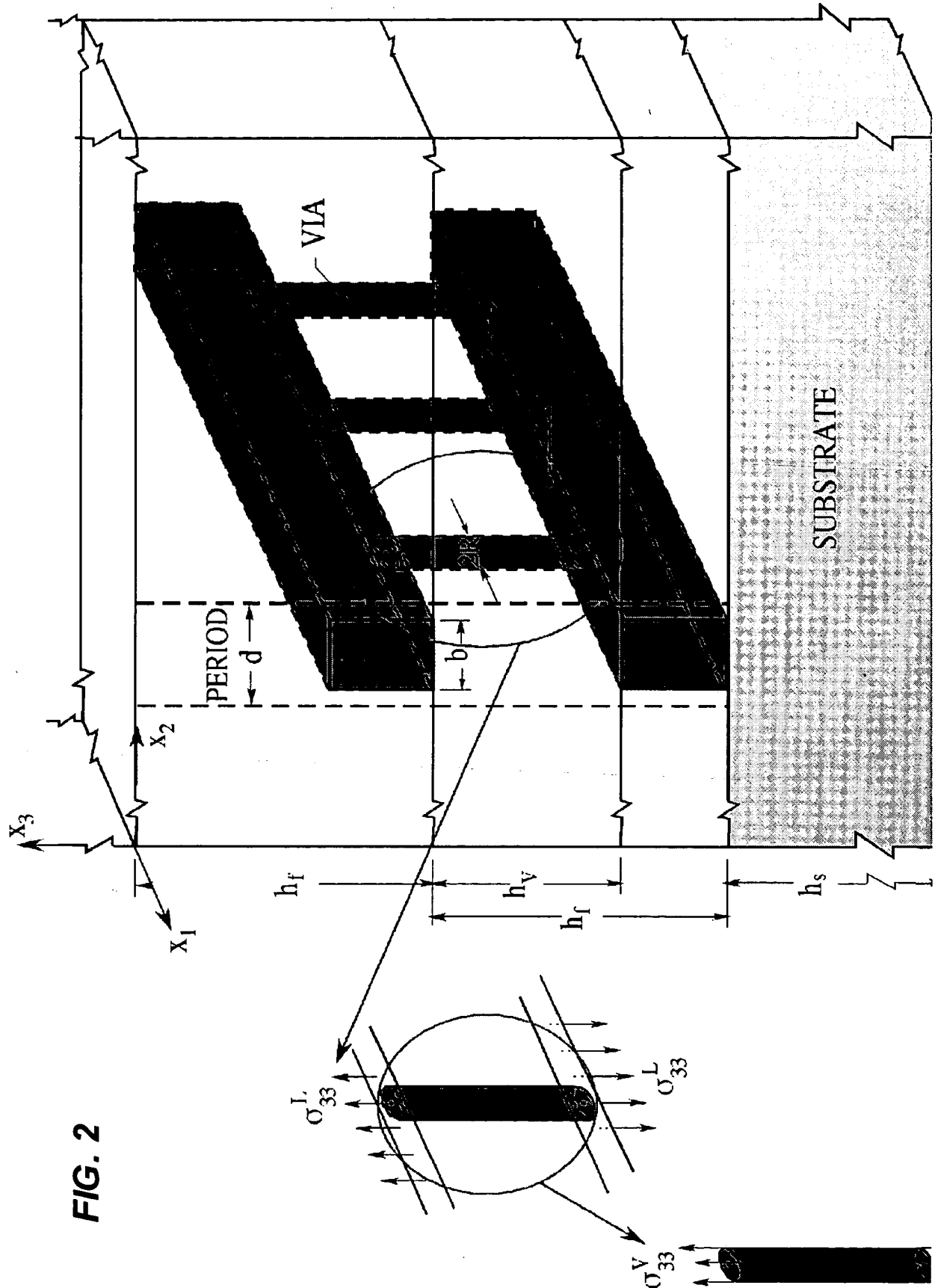


Applicant(s): Ares Rosakis, et al.

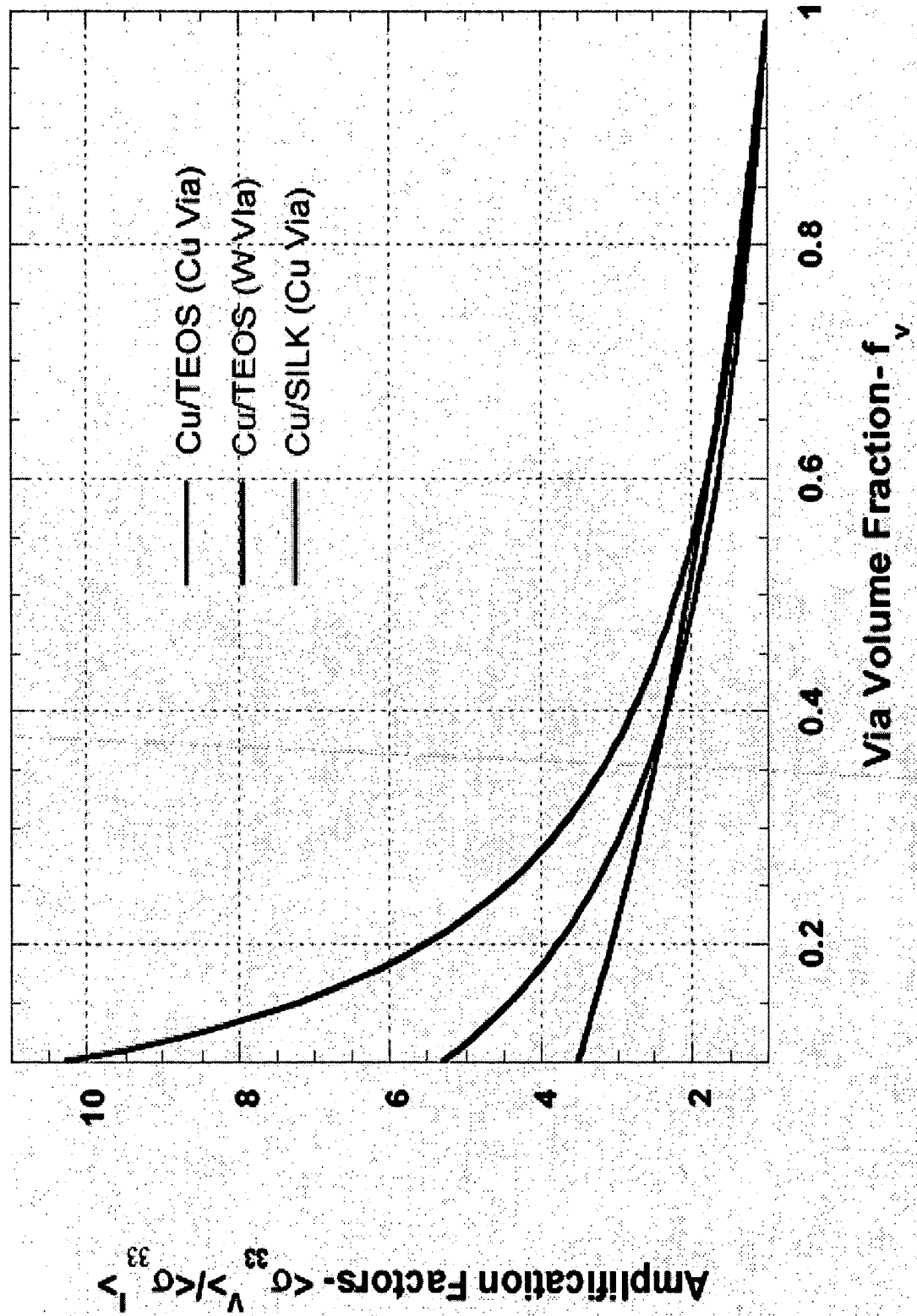
ANALYSIS AND MONITORING OF STRESSES IN  
EMBEDDED LINES AND VIAS INTEGRATED ON  
SUBSTRATES

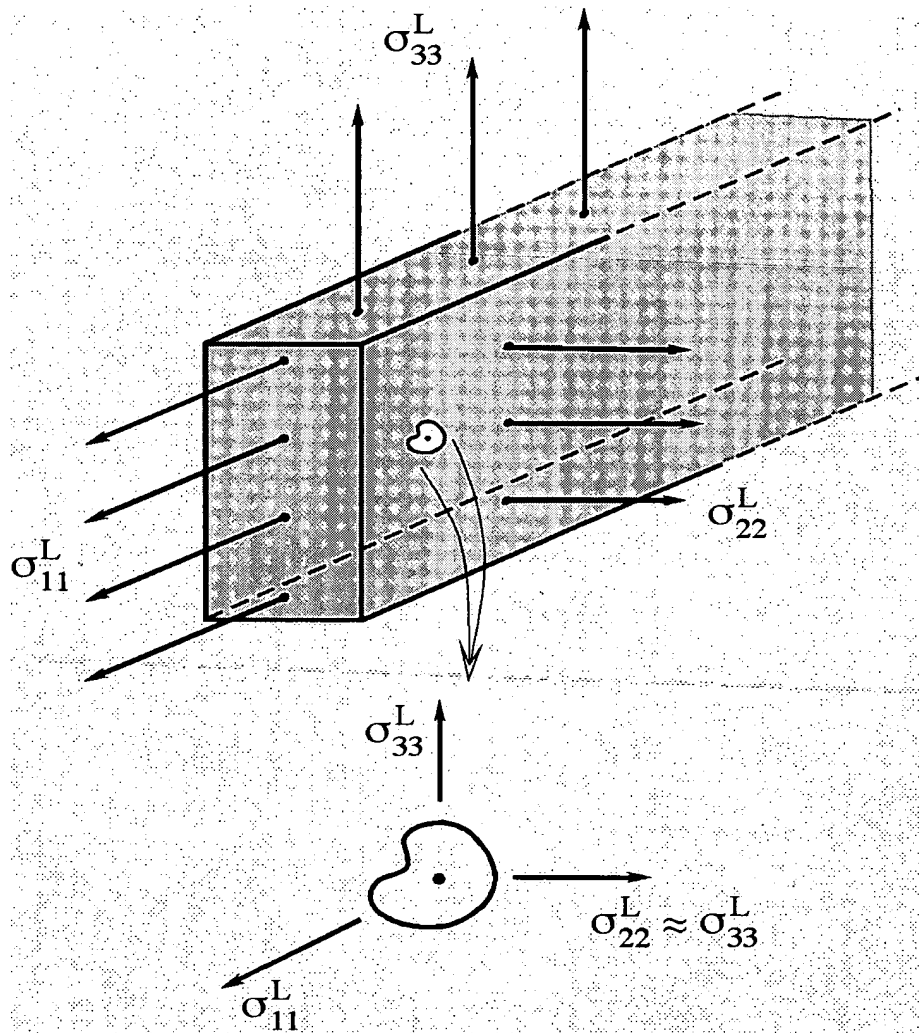
**FIG. 1B**



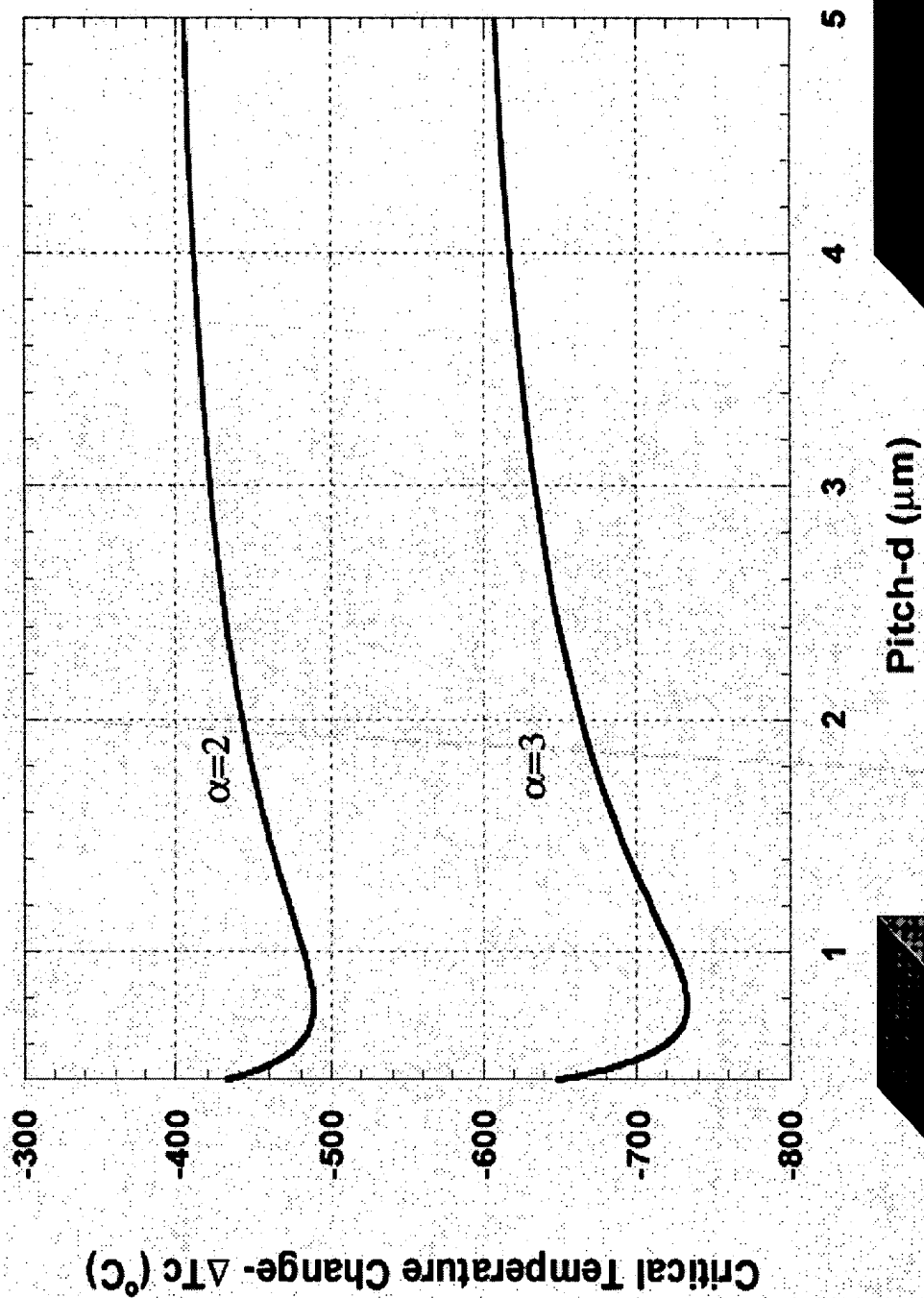
$$E_{Cu}=110\text{GPa}, \alpha_{Cu}=17 \times 10^{-6}/^{\circ}\text{C} \quad E_{TEOS}=59\text{GPa}, \alpha_{TEOS}=1 \times 10^{-6}/^{\circ}\text{C}$$

$$E_W=410\text{GPa}, \alpha_W=4.3 \times 10^{-6}/^{\circ}\text{C} \quad E_{SILK}=2.45\text{GPa}, \alpha_{SILK}=66 \times 10^{-6}/^{\circ}\text{C}$$

**FIG. 3**

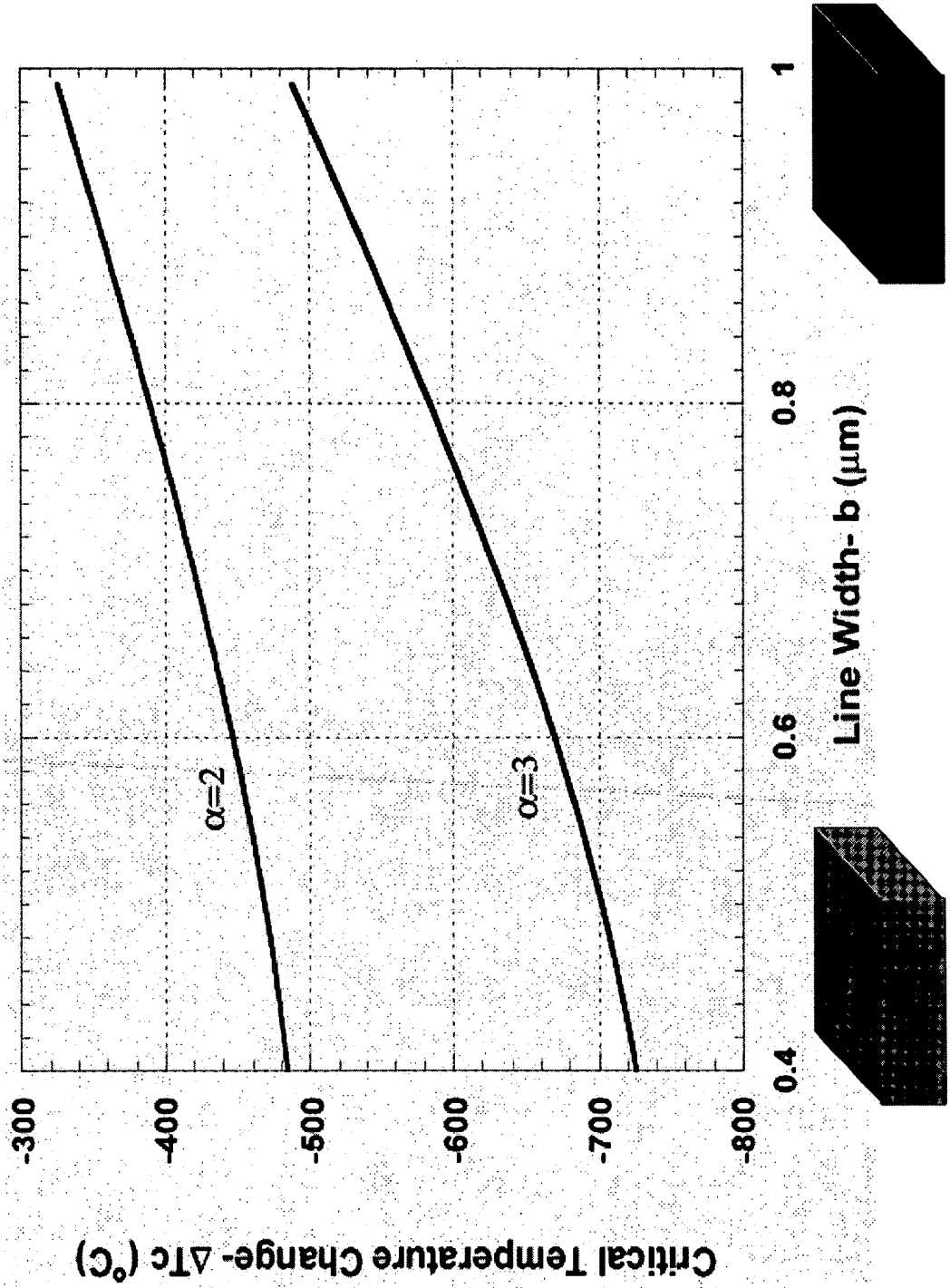
**FIG. 4**

**Materials:** Cu lines, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $b=0.4\mu\text{m}$ ,  $f=b/d$   
**Criterion:**  $\alpha=2$  or  $3$ ,  $\sigma_y=293\text{MPa}$  (using Hall-Petch)

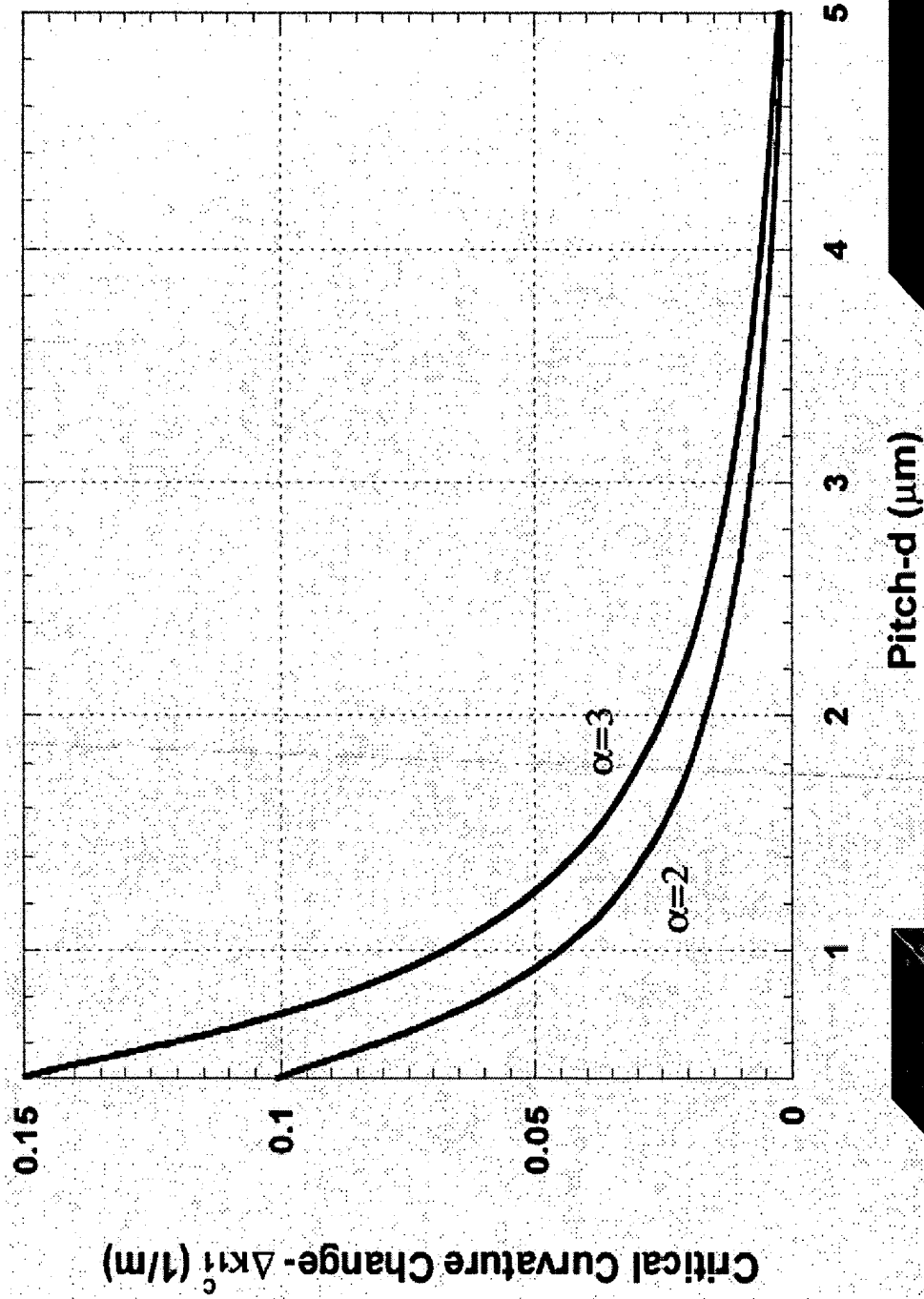


**FIG. 5**

**Materials:** Cu lines, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $d=1.0\mu\text{m}$ ,  $f_l=b/d$   
**Criterion:**  $\alpha=2$  or  $3$ ,  $\sigma_y = 26.9[1 + 6.64\{(t+b)/2\}^{-0.5}] \text{ MPa}$

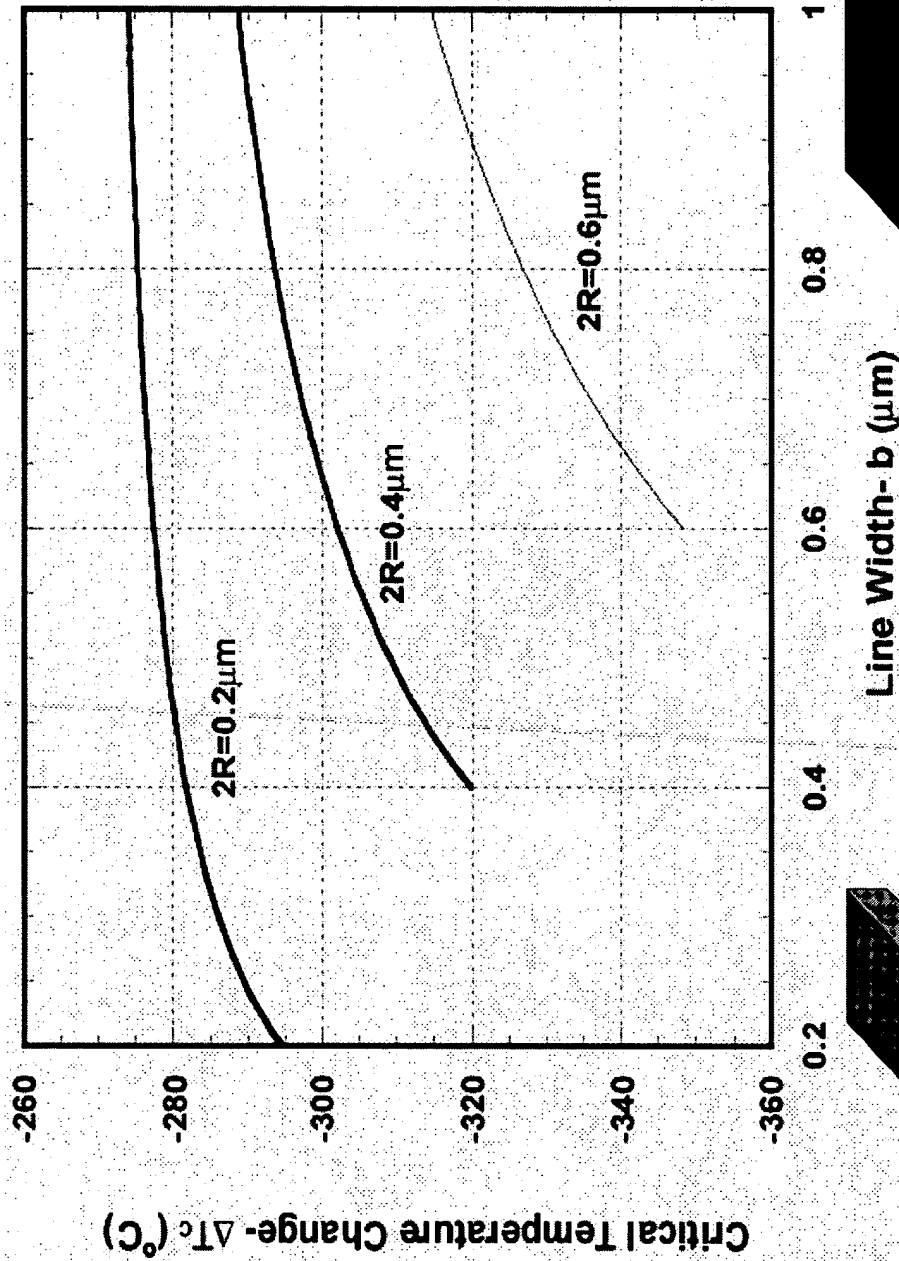
**FIG. 6**

**Materials:** Cu lines, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $b=0.4\mu\text{m}$ ,  $f=b/d$   
**Criterion:**  $\alpha=2$  or  $3$ ,  $\sigma_y=293\text{MPa}$  (using Hall-Petch)

**FIG. 7**

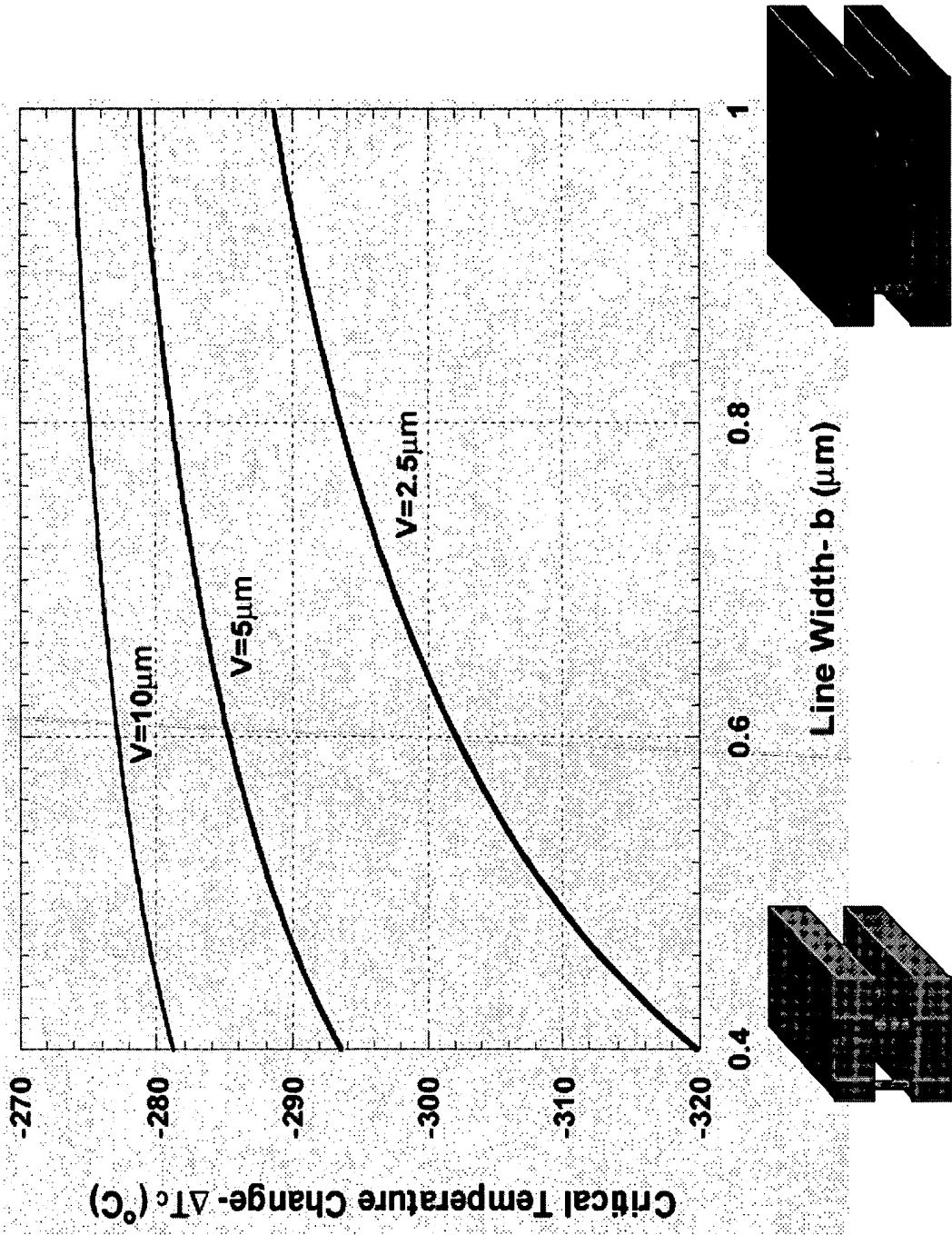


**Materials:** Cu lines/vias, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $f_r=b/d=0.5$ ,  $V=2.5\mu\text{m}$ ,  $f_v=\pi R^2/bV$   
**Criterion:**  $\alpha=3$ ,  $\sigma_y=293\text{MPa}$  (using Hall-Petch)

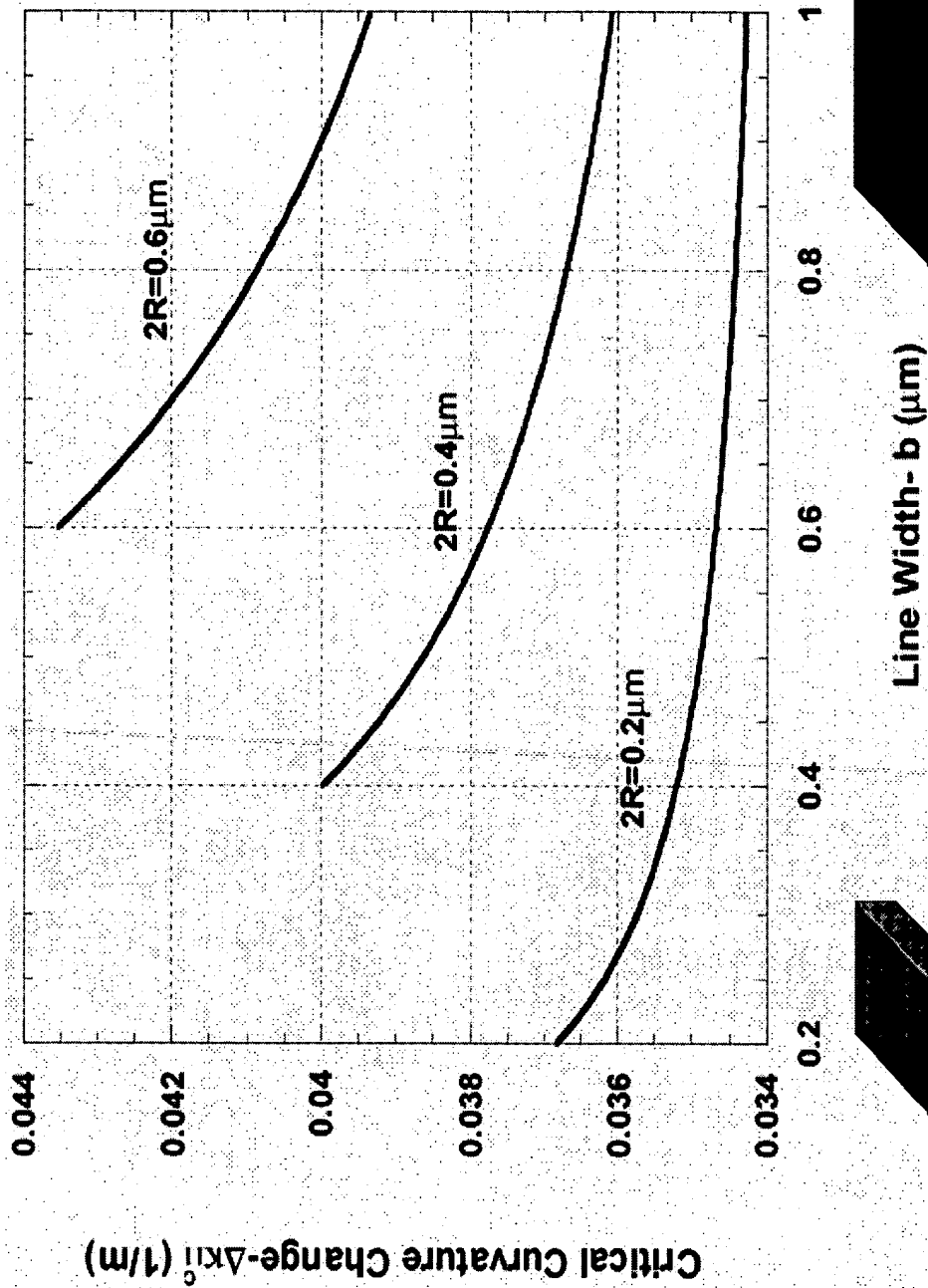
**FIG. 8**

**Materials:** Cu lines/vias, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $f_r=b/d=0.5$ ,  $2R=0.4\mu\text{m}$ ,  $f_v=\pi R^2/bV$   
**Criterion:**  $\alpha=3$ ,  $\sigma_y=293\text{MPa}$  (using Hall-Petch)

**FIG. 9**



**Materials:** Cu lines/vias, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $f_l=b/d=0.5$ ,  $V=2.5\mu\text{m}$ ,  $f_v=\pi R^2/bV$   
**Criterion:**  $\alpha=3$ ,  $\sigma_y=293\text{MPa}$  (using Hall-Petch)

**FIG. 10**

**Materials:** Cu lines/vias, TEOS dielectric, Si Substrate  
**Geometry:**  $t=0.5\mu\text{m}$ ,  $h_s=525\mu\text{m}$ ,  $b=0.4\mu\text{m}$ ,  $f=b/d$ ,  $2R=0.4\mu\text{m}$ ,  $V=2.5\mu\text{m}$ ,  $f_v=\pi R^2/bV=0.125$   
**Criterion:**  $\alpha=3$ ,  $\sigma_y=293\text{MPa}$  (using Hall-Petch)

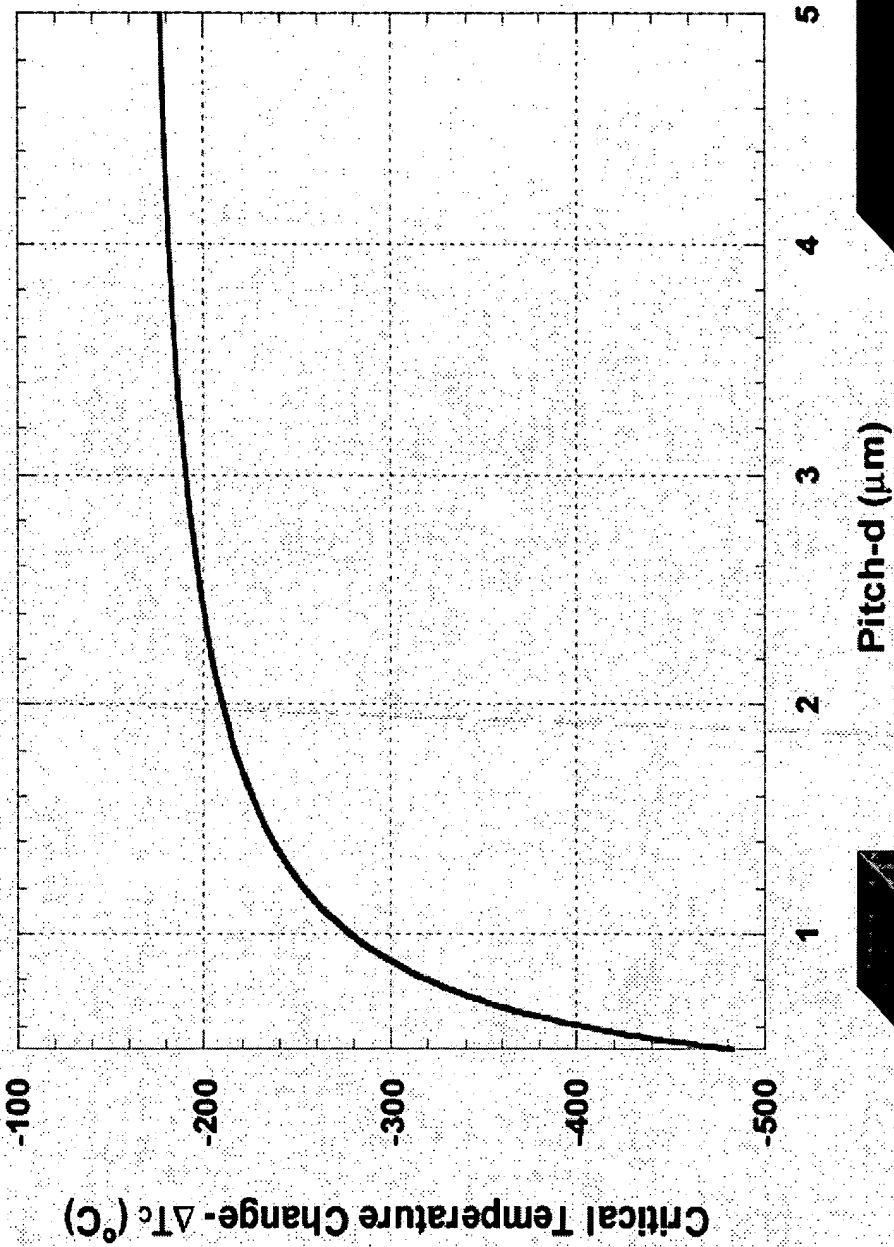
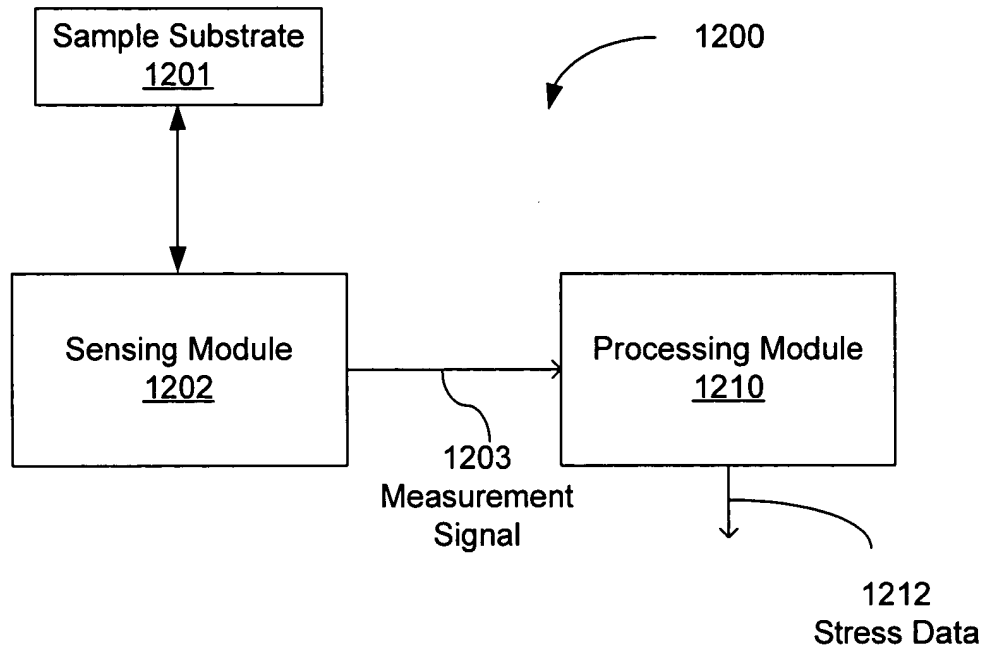
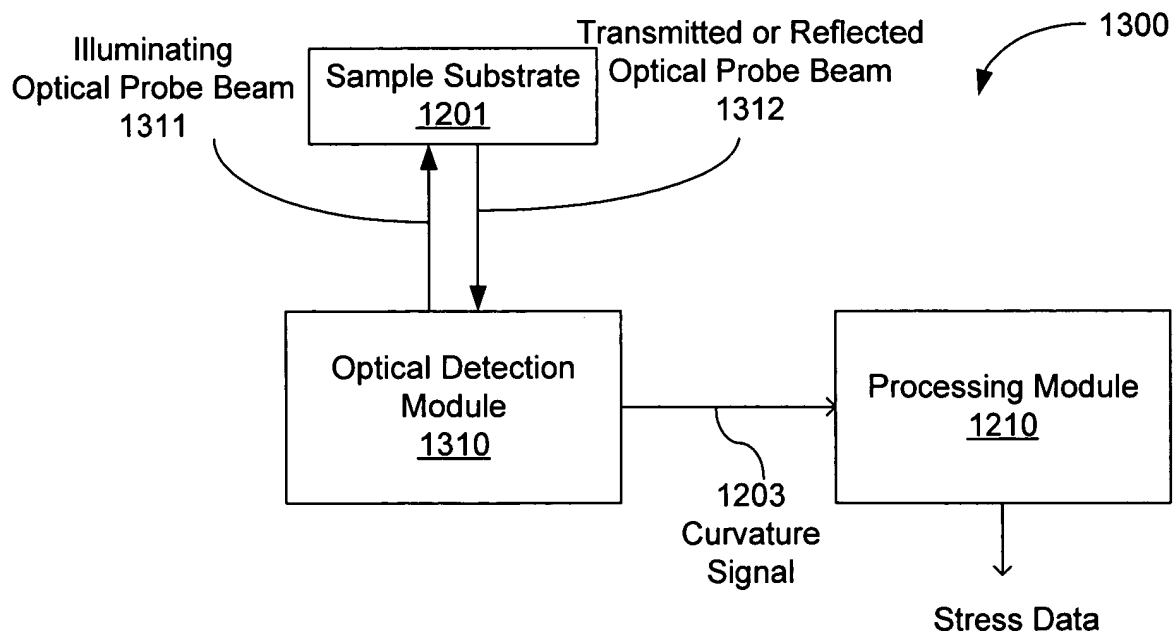
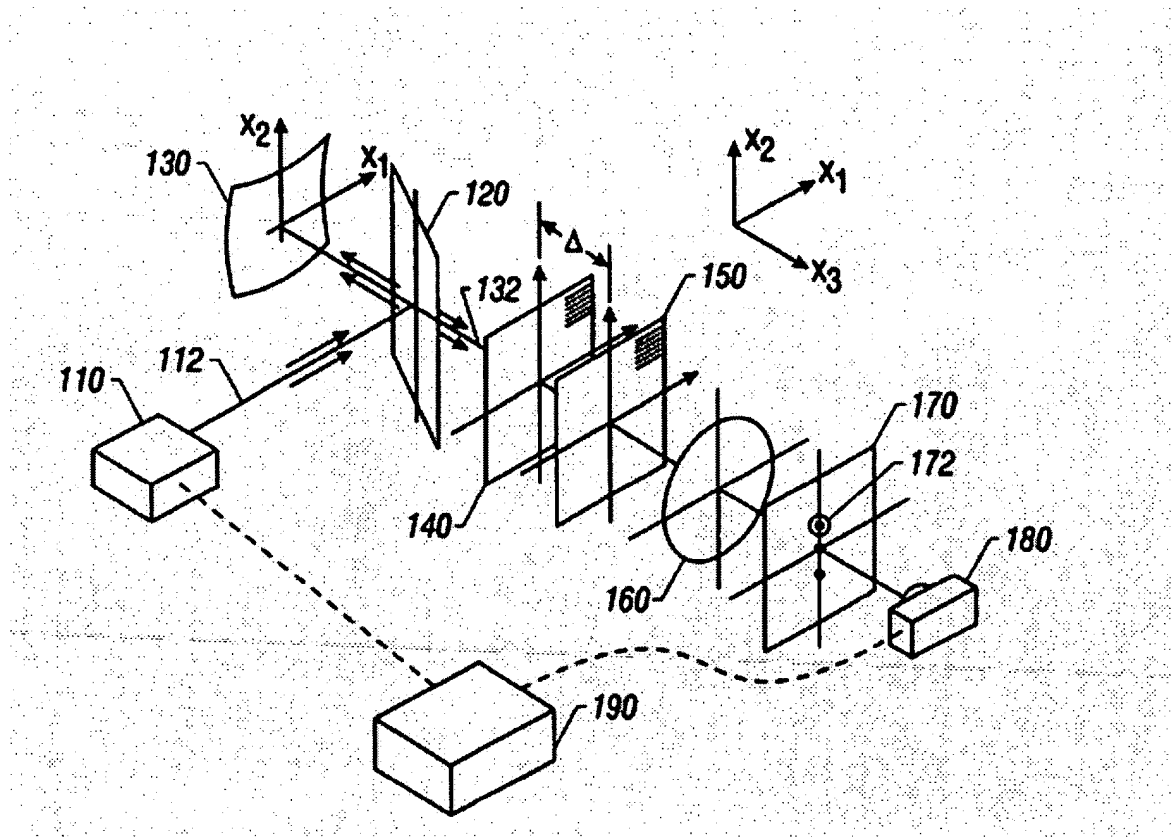
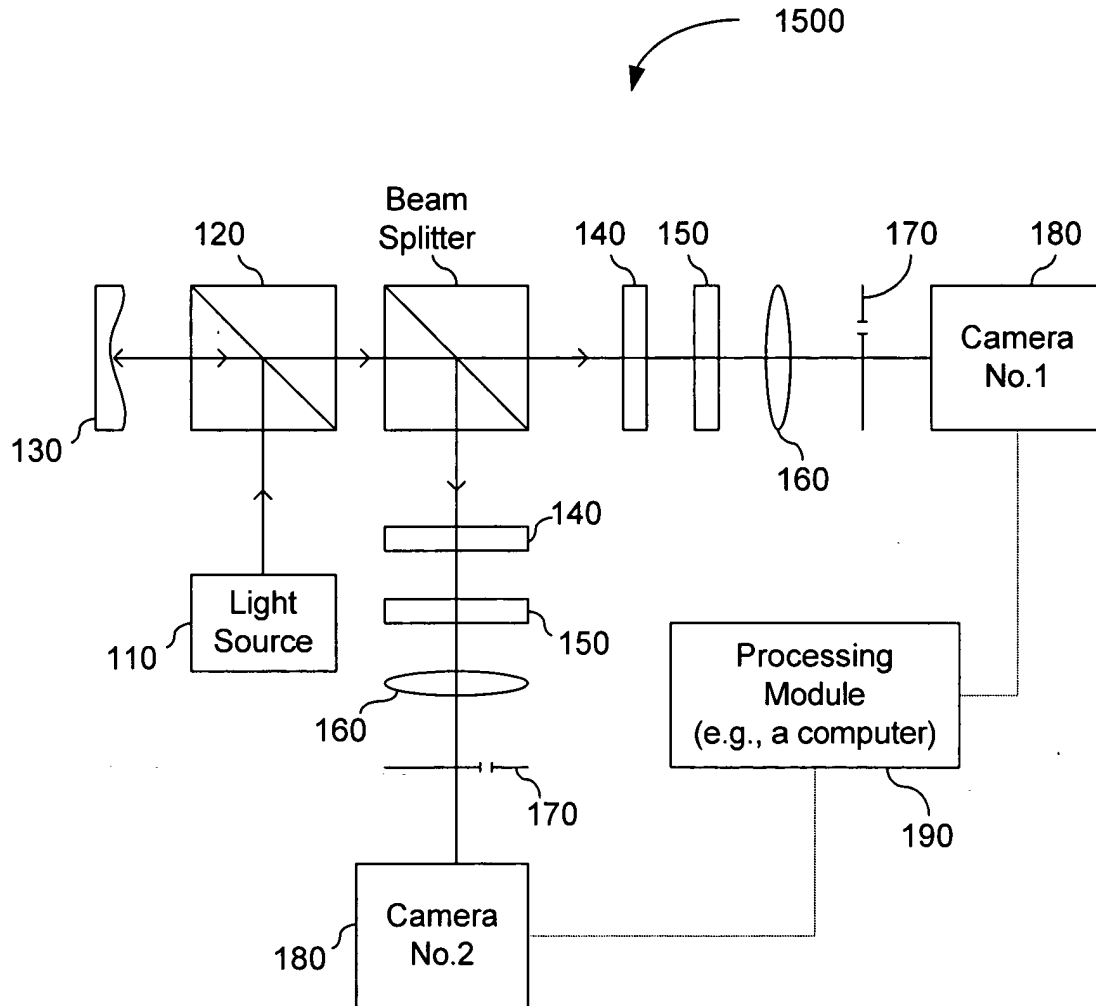


FIG. 11



**FIG. 12****FIG. 13**

**FIG. 14**

**FIG. 15**

**FIG. 16**